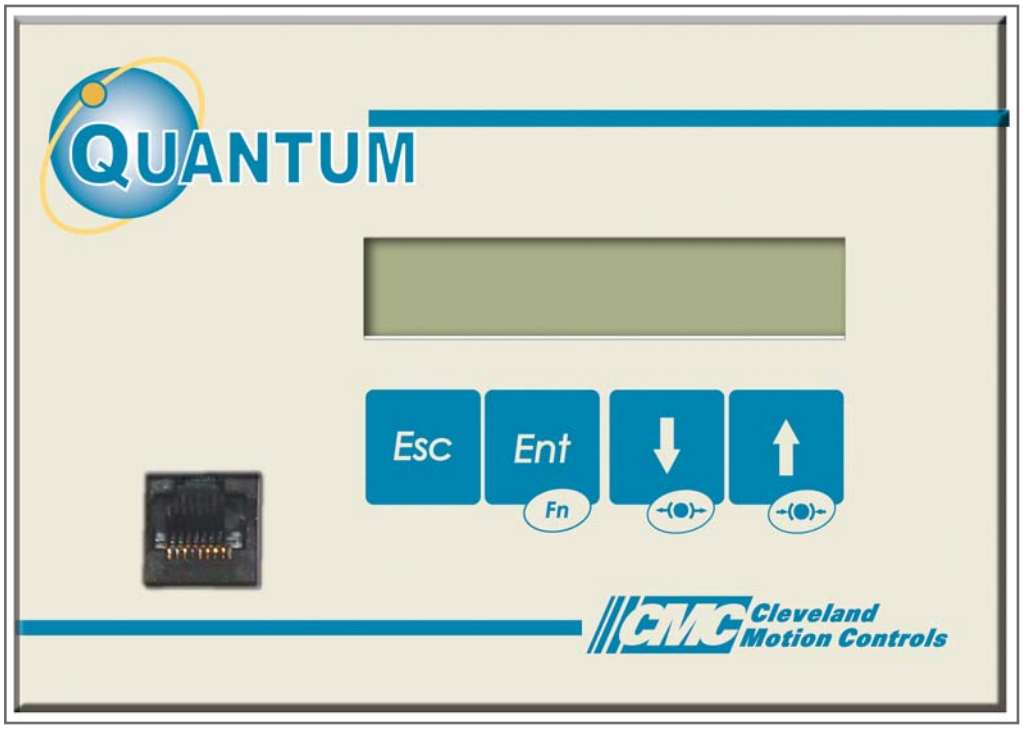
ITT

Cleveland Motion Controls

QUANTUM

USER MANUAL



MAN-70421

TENSION CONTROL

Congratulations on your Cleveland Motion Controls Quantum digital controller!

You have just acquired the most user friendly and powerful digital controller in its category.

This user manual has been designed to give you all the information you need for installation and commissioning.

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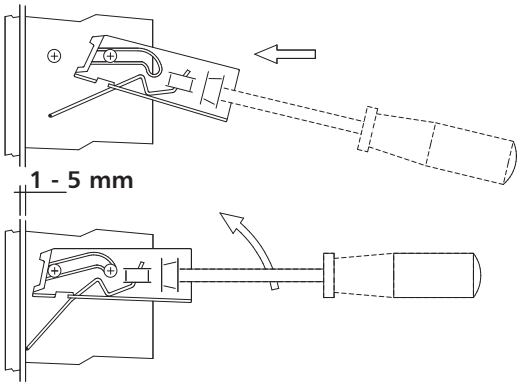
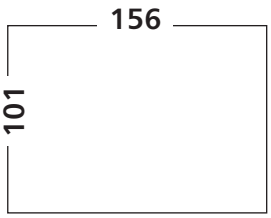
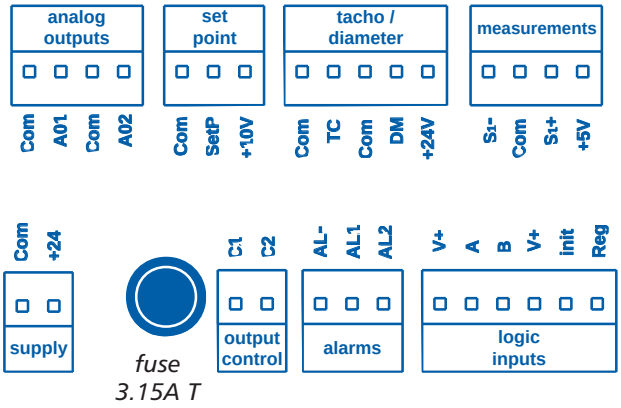
DIMENSIONS - FIXING



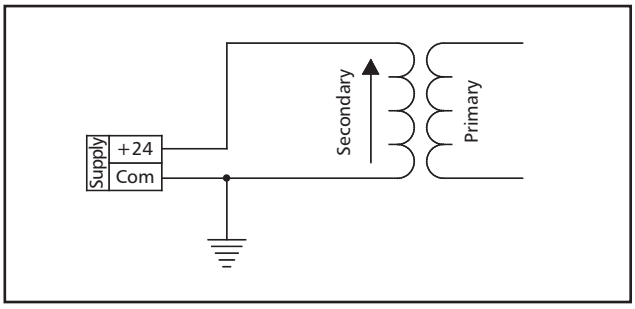


Front panel cutout

BASIC WIRING



Com : 0 V
A01 : analog output control 1 (-10 to +10 V)
A02 : analog output control 2 (-10 to +10 V)
SetP : set point input (0 to 10V, or potentiometer)
+10V : potentiometer supply
TC : tachometer input (0 to 10 V)
DM : diameter input
+24V : Ultrasonic sensor supply
S1- : Signal (-)
S1+ : Signal (+)
+5V : load cell or sensor supply
+24 : supply (24 V AC or DC)
C1-C2 : PWM output (brakes direct supply) 1.5 Amp max.
AL- : ouptut logic reference
AL1 : logic output 1
AL2 : logic output 2
V+ : logic input voltage remote control
A : logic input 1 → *process configuration*
B : logic input 2
init : INIT → *regulator configuration*
reg : REG



Note :
When grounding the secondary of the transformer, please refer to the opposite sketch.

All Com / 0V are linked to the ground

OVERVIEW

User friendly
- Selectable language (En / Fr / Ge / It)
- Selectable Metric or Imperial units
- HOLD and RELEASE on front panel keyboard

Advanced regulation capabilities
- Automatic P.I.D. parameters variation function
- Closed loop + open loop mode
- Inertia compensation control
- Smooth start-up with programmable slope
- E-stop torque proportional to the set point
- Adjustable tapper function available
- No-Stop web turrets management function
- Five complete built-in memories
- Motors & Drives specific settings available

PC software sett-up and debugging
- Unlimited configuration records by software
- Real time full control panel available
- Unlimited real time data record by software

Fully compatible with
- Any current load cell technologies
- One or two, half or full bridge load cells
- US sensors (direct input available)

Built-in PWM Power Supply
- Up to 1.5 Amp available as PWM output voltage
- No need for external power supply with EMAG Brakes

All details about these advanced features are fully available in the Help file included with the PC software supplied with the unit.

SETTING UP

Two different ways are offered for system set-up of your QUANTUM:

- Using the exclusive user friendly set-up software (QUANTUMsoft on a computer.)
  Choose the required type of application, fill in the datafields with your own data, and upload the file to the QUANTUM.
- At any point in the set-up you can click on help in the toolbar, which gives you more details about the procedure.
- Using the front face keypad when there is no computer available (password requested, see p10).
  The procedure is based on the "Initial set of parameters" related to each type of application (on pages 5-8). Enter the data as per the drawing on p10.

System set up procedure to be followed

1 - Sensor(s) calibration

Follow the automatic calibration procedure

Software : Download the related ".prm" file See -> Input Menu in the QUANTUMsoft and enter the data fields related to the chosen application

Keypad : Follow -> Input > Measure > ... (load cells)
Follow -> Input > Diameter > ... (US sensor)

2 - Set point value

Open loop: enter a percentage of the full scale

Closed loop: enter directly the target value

Note: The Set Point value can be adjusted at any time from the front panel keypad

3 - Input/Output definition

Software: See -> Input and Output Menus and enter the data fields related to the chosen application

Keypad: Enter the parameters shown on the table

4 - Dynamic parameters (regulation and stability)

Software: See -> Regulation Menu and enter the data fields related to the chosen application

Keypad: Enter the parameters shown on the table

Stability: When necessary adjust the parameters (*) to improve the system stability

Note: Variable PID (coefficients are proportional to the diameter) is also available when system stability cannot be obtained (diameter measurement must be available).
Detailed features about the Variable PID are fully available in the Help file included to the PC software

CAUTION: **Ensure the required "Process" (link to the machine automation) is active before starting the system (logic input B)**

Troubleshooting

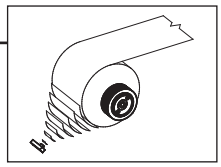
Check: All wiring, in particular ensure cable shields are properly connected

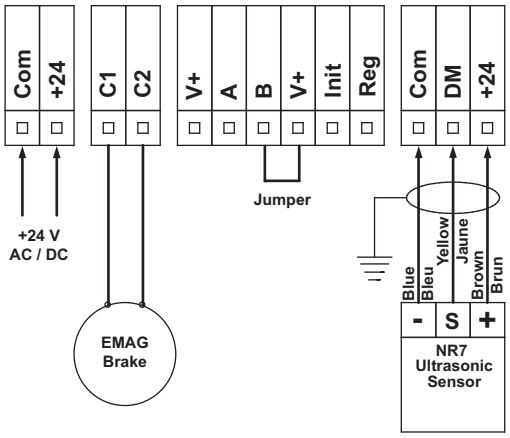
Ensure the parameter settings are in full accordance with the related applications tables

TYPICAL APPLICATION EXAMPLES

WIRING UNWIND WITH EMAG BRAKE AND ULTRASONIC SENSOR

OPEN LOOP



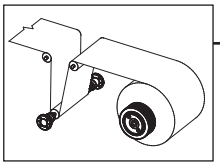


Note : all Com / 0V are linked to the ground

Initial set of parameters

File : Diameter_measurement.prm

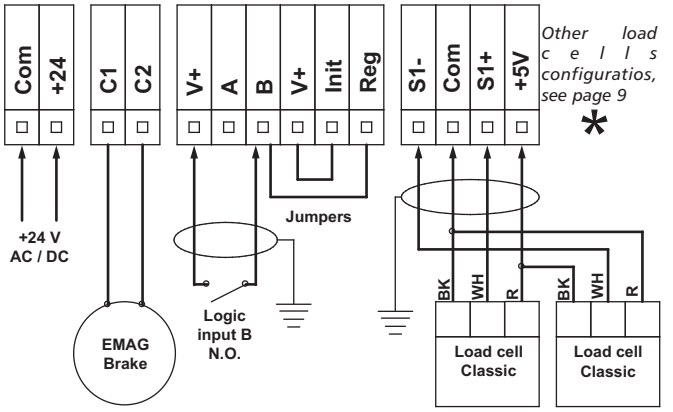
DISPLAY	Line 1	***Set Point***
	Line 2	***Diameter***
FUNCTIONS	Time Delay Start	
	Time Delay Stop	
	Hold	
INPUTS	Set Point	***50***
	Diameter Filtering	***1000***
	Tachymeter Filtering	
OUTPUTS	Upper Limit	***0***
	Bottom Limit	***10***
	Power Gain	***100***
REGULATION	Max Effort	***100***
	P	
	I	
	D	
	Measurement Filtering	
	Open Loop Gain	***100***
	Closed Loop Gain	
	Speed Gain	
	Coeff Speed	
	Overspeed	



UNWIND WITH LOAD CELLS AND EMAG BRAKE

CLOSED LOOP

Wiring



Note : all Com / 0V are linked to the ground

Initial set of parameters

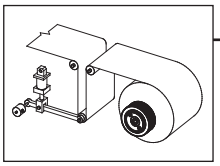
File : Force_feedback.prm

DISPLAY	Line 1	***Set Point***
	Line 2	***Measure***
FUNCTIONS	Time Delay Start	***1***
	Time Delay Stop	***300***
	Hold	***10***
INPUTS	Set Point	***50***
	Diameter Filtering	
	Tachymeter Filtering	
OUTPUTS	Upper Limit	***0***
	Bottom Limit	***10***
	Power Gain	***100***
REGULATION	Max Effort	
	P	***100 (*)***
	I	***20 (*)***
	D	***0***
	Measurement Filtering	***100 (*)***
	Open Loop Gain	***0***
	Closed Loop Gain	***100***
	Speed Gain	***0***
	Coeff Speed	
	Overspeed	***0***

Process

Machine / product stopped : B = 0V (OPEN)
Web Tension = HOLD value (Open Loop)

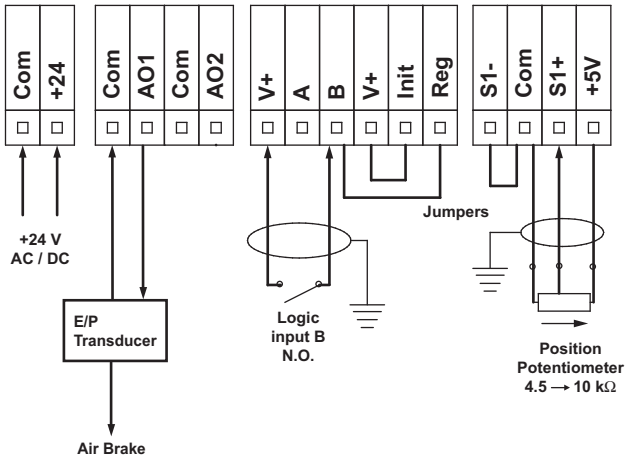
Machine / product running : B = 24V (CLOSED)
Web Tension = SET POINT value (Closed Loop)



UNWIND WITH DANCER AND EMAG BRAKE

CLOSED LOOP

Wiring



Note : all Com / 0V are linked to the ground

Initial set of parameters

File : Dancer.prm

DISPLAY	Line 1	***Set Point***
	Line 2	***Measure***
FUNCTIONS	Time Delay Start	***1***
	Time Delay Stop	***300***
	Hold	***100***
INPUTS	Set Point	***50***
	Diameter Filtering	
	Tachymeter Filtering	
OUTPUTS	Upper Limit	***0***
	Bottom Limit	***10***
	Power Gain	***100***
REGULATION	Max Effort	
	P	***100 (*)***
	I	***5 (*)***
	D	***100 (*)***
	Measurement Filtering	***5***
	Open Loop Gain	***0***
	Closed Loop Gain	***100***
	Speed Gain	***0***
	Coeff Speed	
	Overspeed	***0***

Process

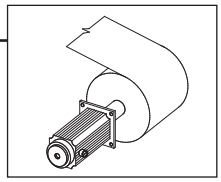
Machine / product stopped : B = 0V (OPEN)
Web Tension = HOLD value (Open Loop)

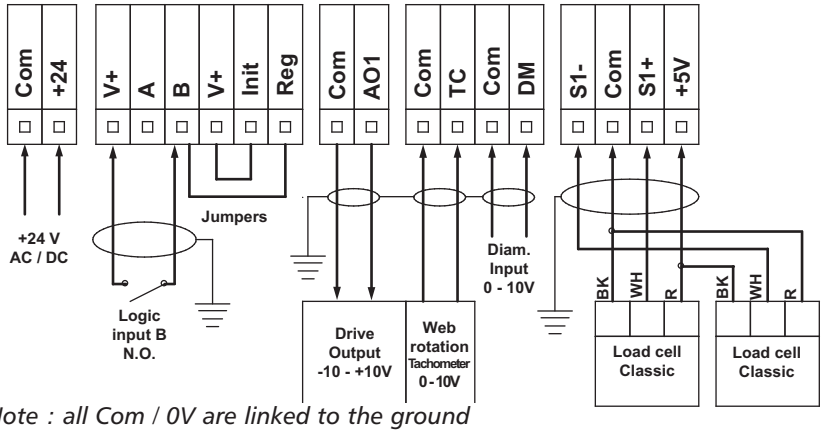
Machine / product running : B = 24V (CLOSED)
Web Tension = SET POINT value (Closed Loop)

Wiring

UNWIND WITH MOTOR AND LOAD CELLS

CLOSED LOOP





Note : all Com / 0V are linked to the ground

Process

Machine / product stopped : B = 0V (OPEN)
Web Tension = HOLD value (Open Loop)

Machine / product running : B = 24V (CLOSED)
Web Tension = SET POINT value (Closed Loop)

Initial set of parameters

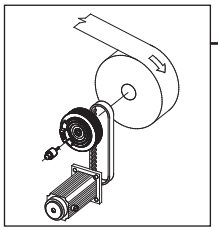
File : Force_motor.prm

DISPLAY	Line 1	***Set Point***
	Line 2	***Measure***
FUNCTIONS	Time Delay Start	***1***
	Time Delay Stop	***300***
	Hold	***10***
INPUTS	Set Point	***100***
	Diameter Filtering	***1000***
	Tachymeter Filtering	***100***
OUTPUTS	Upper Limit	***0***
	Bottom Limit	***10***
	Power Gain	***100***
REGULATION	Max Effort	
	P	***10 (*)***
	I	***5 (*)***
	D	***0***
	Measurement Filtering	***100 (*)***
	Open Loop Gain	***0***
	Closed Loop Gain	***100***
	Speed Gain	***Calcul 1***
	Coeff Speed	***100***
	Overspeed	***0***

1

Regulation Speed Gain = $(D_{min} \times V_l) / V_r$

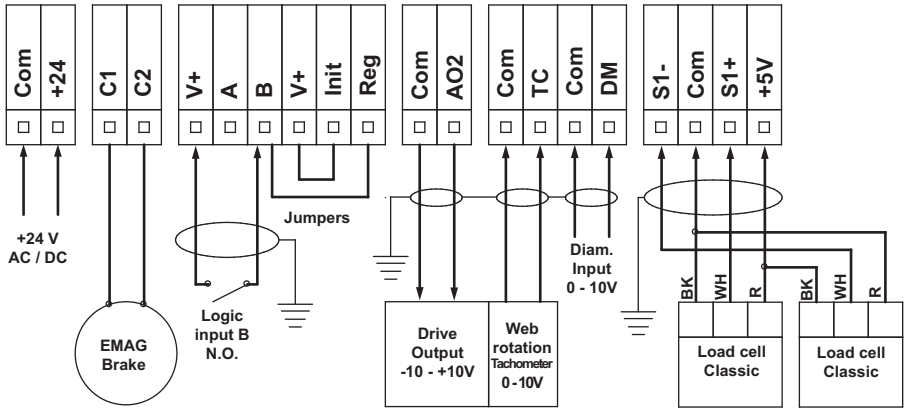
D_{min} *[m]*	*Min web diameter*
V_l *[m/min]*	*Linear speed for 10V output from tachometer*
V_r *[RPM]*	*Max speed of the drive motor (when set point output =10 V on AO1)*



REWIND WITH LOAD CELL + CLUTCH/MOTOR

Wiring

CLOSED LOOP



Initial set of parameters

File : Force_clutch_motor.prm

DISPLAY	Line 1	***Set Point***
	Line 2	***Measure***
FUNCTIONS	Time Delay Start	***1***
	Time Delay Stop	***300***
	Hold	***10***
INPUTS	Set Point	***100***
	Diameter Filtering	***1000***
	Tachymeter Filtering	***100***
OUTPUTS	Upper Limit	***0***
	Bottom Limit	***10***
	Power Gain	***100***
REGULATION	Max Effort	
	P	***100 (*)***
	I	***20 (*)***
	D	***0***
	Measurement Filtering	***100 (*)***
	Open Loop Gain	***0***
	Closed Loop Gain	***100***
	Speed Gain	***Calcul 1***
	Coeff Speed	***0***
	Overspeed	***Calcul 2***

Process

Machine / product stopped : B = 0V (OPEN)
Web Tension = HOLD value (Open Loop)

Machine / product running : B = 24V (CLOSED)
Web Tension = SET POINT value (Closed Loop)

1

Regulation Speed Gain = $(D_{min} \times V_l) / V_r$

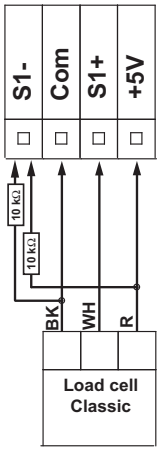
D_{min} *[m]*	*Min web diameter*
V_l *[m/min]*	*Linear speed for 10V output from tachometer*
V_r *[RPM]*	*Max speed of the drive motor (when set point output =10 V on AO2)*

2

Overspeed = $(S_s \times AO2_{max}) / V_r$

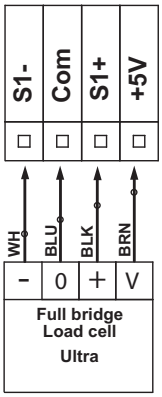
S_s *[RPM]*	*Slipping speed (**60** RPM recommended)*
$AO2_{max}$ *[V]*	*Max output from AO2 : **10** V*
V_r *[RPM]*	*Max speed of the drive motor (when set point output =10 V on AO2)*

OTHER LOAD CELL CONFIGURATIONS



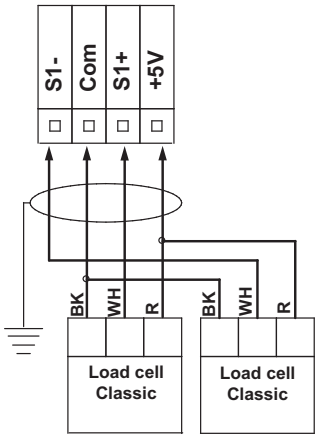
One Load Cell

Half-Bridge
Classic - Series



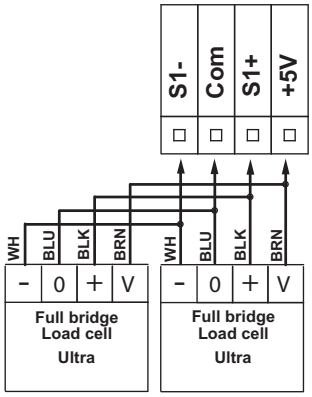
One Load Cell

Full-Bridge
Ultra- Series



Two Load Cells

Half-Bridge
Classic - Series



Two Load Cells

Full-Bridge
Classic - Series

1 – SET POINT Setting

Hold for increase

Hold for decrease

Esc

Escape from Setting mode

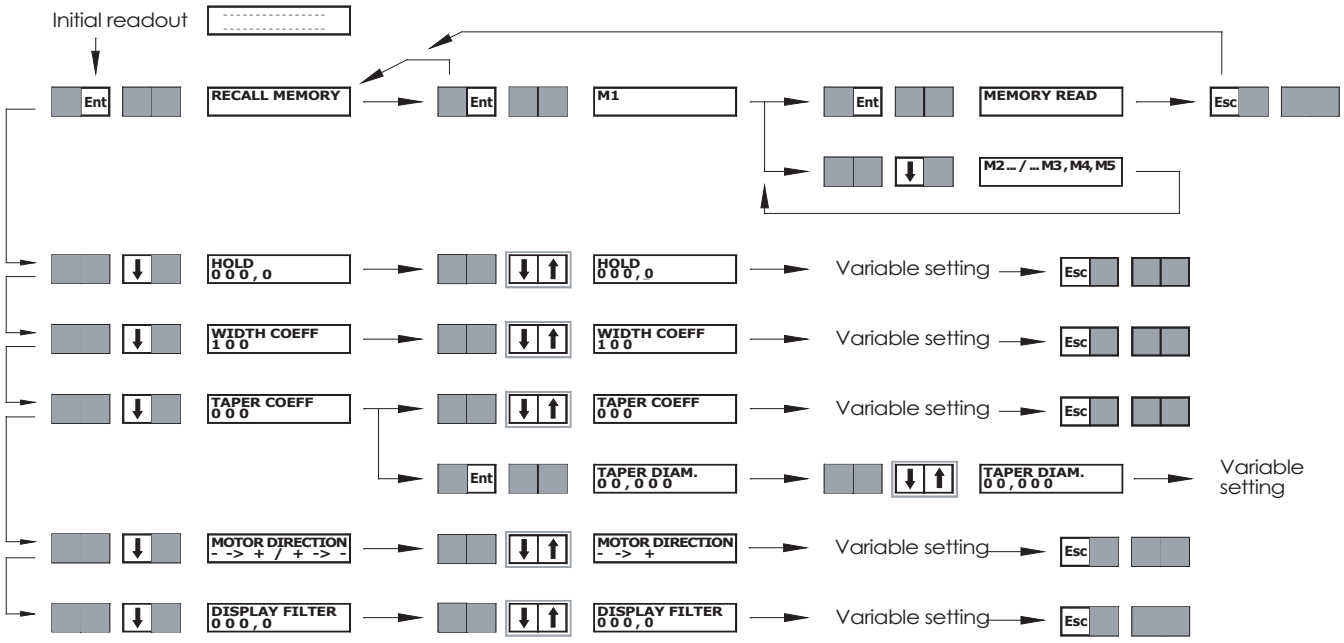
2 – Variable Setting

- Press both buttons simultaneously to enter the Data field (visible underscore)
- Press once to increase/decrease one digit

Ent

- Press to validate each digit
- Last digit validation sends the complete value to the system (underscore disapears)

4 – System General Settings



3 – Additional functions

Releasing Mode

Ent

Press both buttons simultaneously to release the system (Output = 0)

Esc

Escape from releasing

Hold Mode

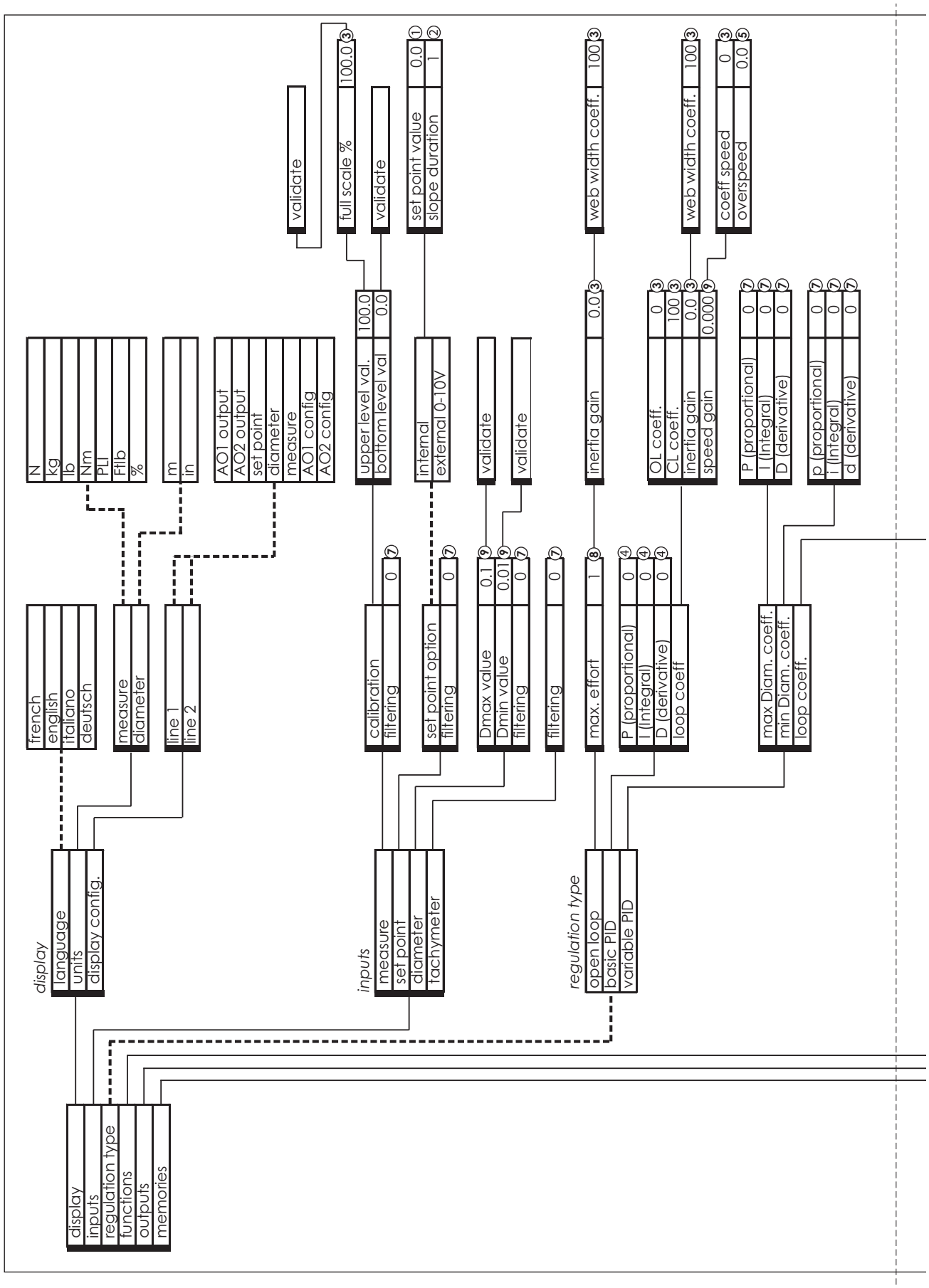
Ent

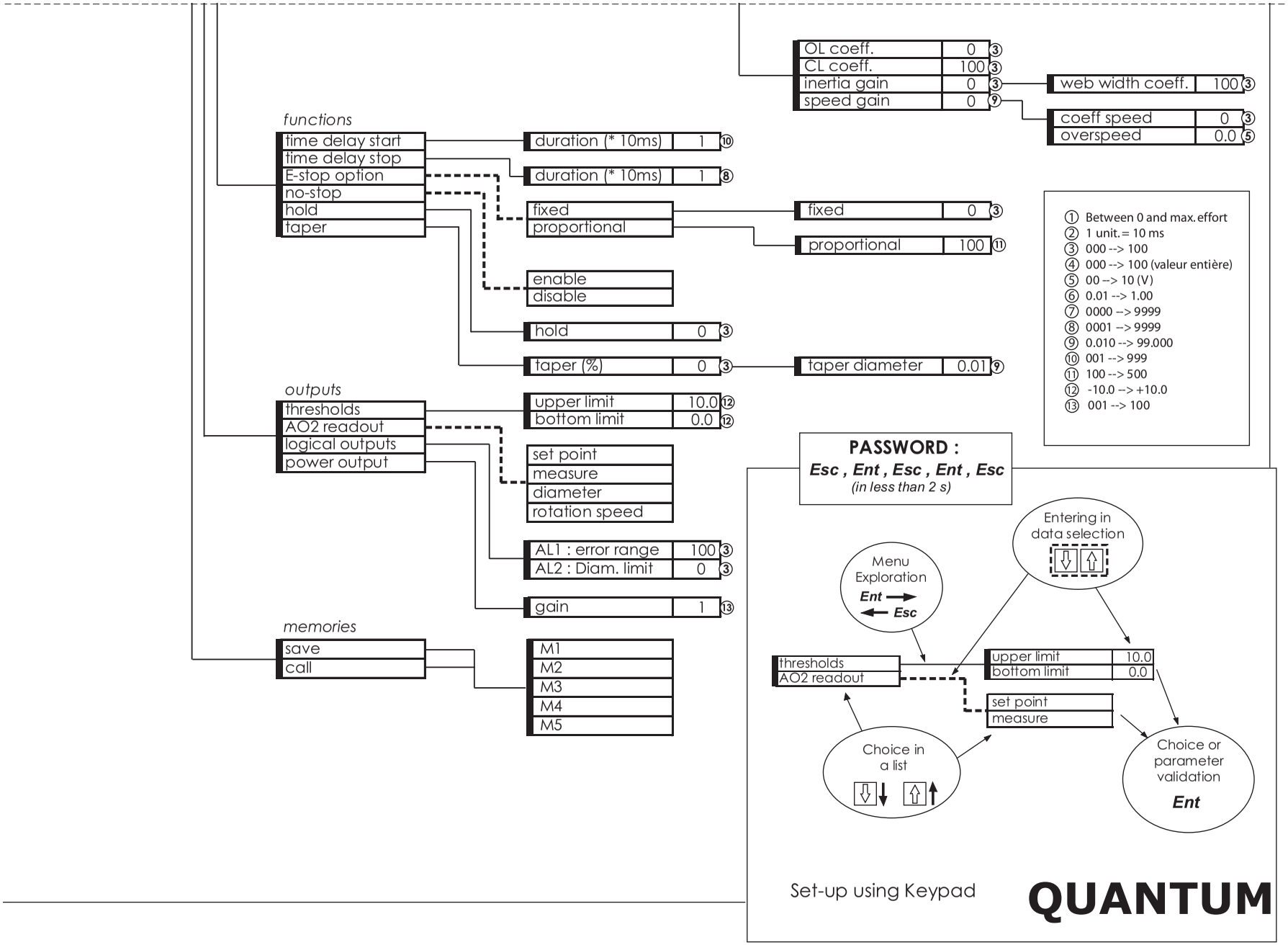
Press both buttons simultaneously to block the system (Output = Max)

This value may be adjusted (see « SET POINT settings »)

Esc

Escape from Hold


display
language
units
display config.
french
english
italiano
deutsch
measure
diameter
N
kg
lb
Nm
PLI
Ftlb
%
m
in
line 1
line 2
inputs
measure
set point
diameter
tachymeter
calibration
filtering
AO1 output
AO2 output
set point
diameter
measure
AO1 config
AO2 config
upper level val.
bottom level val
validate
full scale %
validate
set point option
filtering
internal
external 0-10V
Dmax value
Dmin value
filtering
validate
validate
filtering
regulation type
open loop
basic PID
variable PID
max. effort
inertia gain
P (proportional)
I (Integral)
D (derivative)
loop coeff
OL coeff.
CL coeff.
inertia gain
speed gain
web width coeff.
web width coeff.
coeff speed
overspeed
P (proportional)
I (Integral)
D (derivative)
max Diam. coeff.
min Diam. coeff.
loop coeff.
p (proportional)
i (integral)
d (derivative)
display
inputs
regulation type
functions
outputs
memories


OL coeff. 0 ③
CL coeff. 100 ③
inertia gain 0 ③
speed gain 0 ⑨
web width coeff. 100 ③
coeff speed 0 ③
overspeed 0.0 ⑤
functions
time delay start
time delay stop
E-stop option
no-stop
hold
taper
duration (* 10ms) 1 ⑩
duration (* 10ms) 1 ⑧
fixed
proportional
fixed 0 ③
proportional 100 ⑪
enable
disable
hold 0 ③
taper (%) 0 ③
taper diameter 0.01 ⑨
outputs
thresholds
AO2 readout
logical outputs
power output
upper limit 10.0 ⑫
bottom limit 0.0 ⑫
set point
measure
diameter
rotation speed
AL1 : error range 100 ③
AL2 : Diam. limit 0 ③
gain 1 ⑬
memories
save
call
M1
M2
M3
M4
M5
① Between 0 and max. effort
② 1 unit. = 10 ms
③ 000 --> 100
④ 000 --> 100 (valeur entière)
⑤ 00 --> 10 (V)
⑥ 0.01 --> 1.00
⑦ 0000 --> 9999
⑧ 0001 --> 9999
⑨ 0.010 --> 99.000
⑩ 001 --> 999
⑪ 100 --> 500
⑫ -10.0 --> +10.0
⑬ 001 --> 100
PASSWORD :
Esc , Ent , Esc , Ent , Esc
(in less than 2 s)
Entering in data selection
Menu Exploration
Ent
Esc
thresholds
AO2 readout
upper limit 10.0
bottom limit 0.0
set point
measure
Choice in a list
Choice or parameter validation
Ent
Set-up using Keypad
QUANTUM

PC SOFTWARE - INSTALLATION AND USE

The CD-Rom delivered with your box contains a PC software dedicated to the QUANTUM, called QUANTUMsoft.

Launch the "Setup" file to automatically install the software on your PC in:
"C:\ProgramFiles\cmc\quantum\"
During the installation process, a shortcut is automatically created in Run\Programs

The application is launched by a double click on the icon.

To open a pre-set application parameter file, two possibilities are offered:
- click on the thumb index in 'parameter' then 'new' and choose the application type which is appropriate to you.
- click on 'File' then 'open parameters files…'and under C:\ProgramFiles\merobel\DGT3Soft, open the file .prm related to your application.

- for direct access to the related help, click the right mouse button.

If you meet problems when installing the QUANTUMsoft on your computer, ensure the following points:
- the operating system is Windows XP.
- In the event of defect of COM during the launching of the application, make sure that the cable is properly connected to the COM1 of the PC.

If COM1 is not available, configure the application to work on an alternative port (ex. COM2), according to following instructions :

. create a shortcut on the desktop for the QUANTUMSoft.exe application.
. click in the properties of the shortcut (right click on the shortcut icon).
. in the thumb index shortcut, write in the target after the access path - com2
(ex. : "C:\Program Files\Program Files\cmc\QUANTUM\quantum.exe" - com2).

NOTES

Parameter

1.1 Communicate parameters to regulator

Save or load a set of parameters on the PC
To save a set of parameters, click in the thumb index **'file'** then choose **'save as…'** for recording in a new file (file..PRM.), or **'recording'** to record the set of parameters in the file in progress.

To open a set of parameters, click in menu **'file'**, then choose **'open…'.** The set of parameters will automatically load in the right interface.

The banks of memories of the regulator
There are five internal memories M1 to M5 in the QUANTUM. The memory in progress is selected by the front panel.

Read the parameters of the regulator
PC software can read these 5 memory banks by clicking on **'read parameter'** or in the thumb index **'regulator'** then **'read from regulator'** and select the memory.

Send the parameters to the regulator
-To send a set of parameters, you can use the menu 'Regulator,' then 'send to regulator.' Then select the memory bank in which you want to record the parameters. There is a direct access to the memories in the icon bar (button 1 to 5).

Parameter

1.2 Begin a new parameter setting

Choose the type of parameter setting

Before beginning a new parameter setting, you must select the application type:
Click in menu 'Parameter,' or in the thumb index 'Parameter' then 'New,' choose your application.

-Open loop
 Tension control application by measurement of the diameter
 Inertia compensation with analogical line speed information
-Closed loop
 Tension control application by measurement of the tension or the torque.
 Dancer application (control of the dancer roll position)
-Inertia compensation
 Tension control application when inertia becomes dominating in the transitional phases.
-Motor command
 Use for intermediate tension control or rewinding application with motor speed control
-Speed follower
 Use for rewinding application with motorized clutch. The goal is to control the tension with the clutch and to control the slipping speed in the clutch to undersize it

Each of these application types requires a different set of parameters, choose the category corresponding to your use of the QUANTUM.

Modify the parameters

The parameters are divided into three or four menus (according to the application type). Click on the button of one of these menus to modify the contents of it.
Once the parameter setting is finished, you can save it or send to the regulator.

Caution! *If you do not save, the set of parameters will be lost when you close the interface.*

Menu INPUTS

2.1 Measure Menu

This menu appears when choosing closed loop, inertia correction,motor command or speed follower. It allows calibration for any type of measurement, from a few mV to 10V.

Measure calibration

% full scale: Type in the percentage of full scale corresponding to the upper point used during calibration (this percentage must be more than 20%).
Valid high level: Type in the value for the upper point.
Valid low level: Type in the value for the lower point.

Procedure:
Fill the 3 parameters and then click on the memory used. Then physically simulate the upper point and click "valid high level," wait 5 seconds (yellow button), physically simulate the lower point and click "valid low level," wait 5 seconds (yellow button); calibration is complete.

2.2 Set Point Menu

Two types of set points are available
-Internal set point: type in the chosen value, it can be modified by the operator with the arrows on the keyboard. A ramp can be used for soft start. The ramp is activated when the switch Regulator is turned on.
-External 0-10V set point: Potentiometer or PLC connected to "set point" pin.

The set point unit is given in menu DISPLAY.

Open loop case:
In this case, the parameter Max Effort must be given. It corresponds to the max product tension.
This parameter is used to calibrate the system since there is no measure.

Example: CMC Magnetic Particle Brake (EMAG 26)
Nominal torque = 35 Nm at 1 A.
Bobine max diameter = 1 m.
Max current in brake = 0.5 A.
1/ from the EMAG 26 torque vs current, we obtain 0.5A = 22.5Nm.
2/ Max Effort = 22.5Nm / 0.5m = 45N.
Max Effort = 45N (or 4.5kg).

2.3 Diameter Menu

Diameter calibration

With an analog diameter measure, the signal must be calibrated from physical values (upper point = max diameter, lower point = min diameter).

Valid max diameter: Type in the max diameter value.
Valid min diameter: Type in the min diameter value.

The diameter unit is chosen in the DISPLAY menu.

Procedure: Fill the values and click on memory used, then physically simulate the max diameter and click on the button "valid max diameter," wait 5 seconds and do the same with min diameter and the button "valid min diameter."

2.2 FILTERING

All the inputs can be filtered. Filtering makes the regulation less sensitive to electric and mechanical disturbances but generates a delay in the system response time.

A few rules:

Measure : Filtering depends on the application and product.
Converting force from 100.
Converting force on elastic product from 400.
Dancer from 0.

Set point: Useful for external set point to filter the signal or simulate a ramp.

Diameter: It is recommended to use filtering on this signal because diameter is changing slowly.
The recommended initial value is 100.

Tachymeter: Try to find a compromise between noise reduction and quick response. The recommended initial value is 10

The QUANTUM uses a first order digital filter, the larger the number you give, the lower the cut off frequency (Fc) will be and therefore the more filtering you will obtain.

Fc	1	2	3	4	5	6	7	8	9	10	12	15
numbers seized	1000	500	330	245	195	162	138	120	106	95	78	62

Fc	18	20	22	25	29	34	40	50	70	110	150	240
numbers seize	51	45	40	35	30	25	20	15	10	5	3	1

3.1 Units / Display

The front panel is used to display measurement values as well as different data used by the Controller. These two menus (Units / Display) have to be used to choose what will be displayed on the two available16 digits lines.

Units

This menu is used to choose the units for the measurement and for the diameter values.

Display

This menu is used to choose what information will be displayed on the two lines. On each line it is possible to choose between the following options :

Display AO1 (idem AO2): Shows the analogic voltage output on AO1 output (resp. AO2).
Set point / Diameter / Measure: Shows the actual Set point / Diameter / Measure, using the chosen unit.
Shows AO1 status (idem AO2): Shows the logic inputs configuration viewed by the Controller (according to A / B digital inputs state), meaning HOLD mode, REGUL mode, RELEASING mode, Estop mode.

4.1 E-STOP function

Principle
The E-stop function could be used for the Emergency stop or for any other particular process. Two different options are available: Fixed E-Stop value and Proportional E-Stop value. The last one sends an output voltage related to the last current output (before switching to the HOLD mode)

How does it work
Fixed HOLD value: by entering a value between 0 - 100% , a proportional value between 0-10V will be sent on the output (i.e. with 50%, 5V will be sent on AO1 output during the HOLD mode).

Proportional HOLD value: input the gain value (100 - 500%).
The last calculated output value before switching to the HOLD mode will be multiplied by the chosen gain (i.e. with an actual output value of 3 V (during the normal regulation), the controller will send 9 V to the ouptut if the gain has been set to 300%.

Process
The E-stop mode is managed by the following digital inputs:
external switch A closed - external switch B closed

4.2 Time Delay Menu

Principle

When the machine process management (motor start and stop) is not synchronized with the controller logical inputs remote control (external switches Reg and B), some regulation troubles can appear. The synchronizing problems can be solved with the time delay options available in the Controller functions.

How it works

Starting time delay: Entering a time delay value (tens of milliseconds), means that the system will wait for that delay before the controller starts the actual calculation (after switching Reg from open to closed position).

Stopping time delay: Entering a time delay value (tens of milliseconds), means that the system will wait for that delay before the controller stops the actual calculation (after switching Reg from closed to open position).

The same effect will be applied on the delay to switch from Regulation mode to Hold mode

Process

It is usually necessary to manage the switches Reg and B simultaneously.

4.3 HOLD function

Principle

The Hold function can be used by the operator for the machine settings (out of regulation mode). It allows the operator to directly manage a constant ouptut voltage level (parameter always available on the controller front panel).

How does it work

***Hold value*:** Entering 0-100% means 0-10V proportional output voltage

Process

Two different ways are available to manage this function:
External switch A open - external switch B open by the front panel operator menu (priority access)

4.4 Inertia

This menu is available for open loop configuration when inertia compensation is required.

Inertia compensation function

The inertia compensation function allows the controller to increase or decrease the output during the acceleration/deceleration periods. This coefficient (inertia gain) is related to the roll inertia (proportional to the actual diameter measurement) and to the actual line speed (tachometer input). When the web width is not constant, it is possible to adjust the calculated inertia term by entering the coefficient Web width (also always available to the operator on the controller front panel).

Calculation - Inertia gain GI:
Data:
Max roll weight M (Kg)
Max roll diameter D (m)
Max line speed VL (m/s)
Decceleration duration T (s)
Rated current for the chosen Brake IC (A)
Max current adjusted on the power supply board IR (A)
Rated torque for the chosen Brake CN (Nm)

Formula :

$$GI = \frac{M \times VL \times D \times IC \times 100}{240 \times T \times CN \times IR}$$

Adjustment procedure:
Proceed with the first tests with the maximum web width (Coeff. Web width = 100 %).
Temporarily disable the open loop control (Closed loop gain = 0 %) to avoid interactions during the adjustment procedure.

- Apply a high filtering coefficient on the diameter input (slow variation input): Diameter filtering = 500
- Enter a low filtering coefficient on the Tachy measurement input to avoid fast transient troubles
- Apply the calculated inertia gain (above formula)
- Start the machine and adjust the inertia gain value to stabilize the actual measurement during acceleration/deceleration periods.

4.5 NO-STOP function

Principle

This function is used to manage two independent outputs (one which is the calculation result output and the second one which is fixed - hold value). This is usually very useful to manage the automatic splice turrets systems.

How does it work

Click in the "No-Stop" special function box to enable the function.

The ouptut currently not affected by the calculation is automatically delivering the Hold or the E-stop value, depending on the status chosen for logical inputs A and B.

Process

See the following table:

A B	AO1	AO2
0 0	Regulation	Hold
0 1	Regulation	E-Stop
1 0	Hold	Regulation
1 1	E-Stop	Regulation

0 means Open / 1 means Closed

NOTE:
When using this "No-Stop" function, the "Demagnetization" function is not available.
The Operator control panel (front face keyboard functions) remains the priority control.
That means that "Hold" or "Freewheel" modes are sent simultaneously on both AO1 and AO2.

5.1 Coefficients Menu

This menu is available for both closed loop and inertia compensation configurations.

5.2 Closed loop + Open loop Control function

When using a closed loop configuration, this function allows integration with an open loop control by using a specific coefficient for each of these control modes; open loop gain and closed loop gain. This function allows additional closed loop control around the result of an open loop control, in order to limit the Measure - Set point difference, to improve the system stability as well as the accuracy.

Calculation - Open loop gain CBO

DATA :
Max Force range F (N)
Max web diameter D (m)
Rated current for the chosen Brake IC (A)
Max current adjusted on the power supply board IR (A)
Rated torque for the chosen Brake CN (Nm)

Formula: $$CBO = \frac{F \times D \times IC \times 100}{2 \times CN \times IR}$$

The result gives the open loop true coefficient. This value can be modified to optimize the system stability.

5.3 Inertia compensation function

The Inertia compensation function allows an additional open loop control to the calculated currrent closed loop result during the acceleration/deceleration periods. This coefficient (inertia gain) is related to the roll inertia (proportional to the actual diameter measurement) and to the actual line speed (tachometer input). When the Web width is not constant, it is possible to adjust the calculated inertia term by entering the coefficient Web width (also available to the operator on the controller front panel).

Calculation - Inertia gain GI:

Data:
Max roll weight M (Kg)
Max roll diameter D (m)
Max line speed VL (m/s)
Decceleration duration T (s)
Rated current for the chosen Brake IC (A)
Max current adjusted on the power supply board IR (A)
Rated torque for the chosen Brake CN (N.m)

Formula: $$GI = \frac{M \times VL \times D \times IC \times 100}{240 \times T \times CN \times IR}$$

Adjustment procedure:

Proceed with the first tests with the maximum Web width (Coeff. Web width = 100%). Temporarily disable the open loop control (Closed loop gain = 0 %) to avoid interactions during the adjustment procedure. Apply a high filtering coefficient on the diameter input (slow variation input): Diameter filtering = 500. Enter a low filtering coefficient on the Tachy measurement input to avoid fast transient troubles. Apply the calculated Inertia gain (above formula). Start the machine and adjust the inertia gain value to stabilize the actual measurement during acceleration/deceleration periods.

5.4 PID Menu

Principle

The P.I.D. is the heart of the controller calculation system when using the Closed loop mode.
P , I , and D parameters are the coefficients which give the actual output result from the Measurement - Set point difference .

CAUTION : the PID calculation must be disabled during the machine rest periods to avoid that a static Measurement - Set point difference increases the output value to the maximum (giving a very high overshoot for the next machine restart) .
The following process has obviously to be managed by the global machine management system ! (using the external switches Reg and Init) .

How does it work

There are two options for the PID calculation principle :Fixed PID (coefficients) or Variable PID (coefficients) which have to be chosen in the PID Menu (" click in the box " choice mode) .
The Variable PID option is very useful when the Fixed PID is unable to keep the same stability level for the whole range of the Web diameter variation .
The Variable PID option offers to define a P, I and D specific value for the min. diameter, and a different one for the max. diameter . the three P, I, and D parameters will be automatically updated in relation to a diameter measurement input (linear variation between min. and max. for each parameter)

P parameter: This parameter is the direct gain on the Measurement - Set point difference .
The P coefficient will directly affect the global system response time .
CAUTION : The higher the value, the higher the response time, but with a lower stability .

I parameter: This parameter is used to cancel the " static error " by the accumulation of this error from the beginning, and by adding this error to the set point until reaching the equality .
When the Measurement - Set point difference becomes null, the Integral value is stabilized.
A high coefficient value will make the system more reactif by decreasing the time for the Measure to reach the Set point actual value .

D parameter: This parameter is used to help the system to react for fast transients.
It is generally only used for the Dancer applications, in order to stabilize the dancer position when the web speed is variable .
CAUTION : this parameter is used for react to transients, but it means that it could be highly sensitive to the electric interferences on the measurement signal .Be very careful to connect the wiring shields at the best .

Process

The PID calculation is managed by the external switches Reg and Init.

Init	Reg	PID calcul mode
0	0	Stopped (blocked)
1	0	initialisation
0	1	processing
1	1	processing

CAUTION : when using the diameter calculation (counters inputs), the initialisation of diameter calculation is managed by the same external switches (Reg = 0 , Init = 1)

5.5 Motor

This menu is available in *motor command* configuration.

Tension control for motorized rewinder in speed regulation.
In this case, we need linear speed (tacho) and diameter information to calculate the rotation speed of the motor.
Motor gain is then the coefficient linking the different parameters:

Motor gain calculation:
Parameters : 10v on diameter input = D (m)
10v on tacho input = Vl (m/min)
10v on output AO1 = speed set point for the drive = Vr (rpm)
Calculation : Motor gain = $\frac{Pi \times D \times Vr}{Vl}$

With this rotation speed calculation, we have an open loop system on the speed control.
To control the tension on the product, the DGT regulates the open loop calculation with a closed loop (PID adjustement) on tension measurement.

For this application, Coefficient motor = 100%

Note : In this configuration, Overspeed = 0.

Special case: Tension control through clutch and speed follower on rewinder
This model is done to solve dissipation problem in clutch on the rewinding side.
The goal is to drive tension on the product with the clutch and drive the motor speed to keep low slipping in the clutch.

AO1 input : dedicated to clutch control (PID regulation with tension control).
AO2 input :dedicated to motor speed control. The DGT calculates the rotation speed with linear speed and diameter information. Motor gain is calculated like here above.

To ensure a minimum slipping for the right working of the clutch, it is necessary to add an overspeed constant (usually equivalent to 60rpm).

Overspeed calculation:
Parameter : 10v on AO2 output = speed set point for the drive = Vr (rpm)
Calculation : overspeed = $\frac{60(rpm) * 10(V)}{Vr\ (rpm)}$ (de 0.0Và 10.0V)

For this application, Coefficient motor = 0% (generate automatically AO2 as speed output).

Important note: If motor gain =0, motor configuration is not validated and settings are memorized as closed loop configuration.

6.1 Working range

Principle
This function defines the two limits for the actual regulation voltage output AO1 (or AO1 and AO2 when using the No-Stop mode) inside the global output range (-10 / + 10 V). Useful function when using the controller with a device which only uses 0 - +10V input.

How does it work
Min. threshold: Means the minimum voltage allowed to the controller regulated output (enter the threshold value between -10V et +10V).

Max. threshold: Means the maximum voltage allowed to the controller regulated output (enter the threshold value between -10V et +10V - must be higher than the Min. threshold already defined).

6.2 DISPLAY output function (AO2)

This function is used to select one of the following four items to be displayed:

-Set point (0 to 10V = whole measurement range as it has already been calibrated)
-Measure (-10V to +10V = whole measurement range as it has already been calibrated)
-Diameter (0 to 10V = 0 to the Max diameter)
-Linear speed for the speed follower menu

Menu OUTPUTS
6.3 Current limitation

Principle
This function limits the current in the coil when using EMAG brakes and EMAG clutches directly. As the supply of the coil is done by a pulse width modulation on the rectified supply of the QUANTUM, the parameter drives the duty cycle of the PWM.

How does it work
Enter a value between 1-100% corresponding to the maximum current for the application.

Example
Case of an EMAG 50 (65Nm - 1A nominal current-200hm impedance) used for a 50Nm maximum torque application (equivalent to 0.7A).

1. QUANTUM supply with a 24Vac transformer.
   The supply of the coil is done on the 24V rectified meaning around 34Vdc.
   The impedance is 20Ohm, so the max available current is 1.7A.
   To limit the current at 0.7A, the duty cycle is 41%.

2. QUANTUM supply with a 24Vdc converter.
   The supply of the coil is done on the 24Vdc
   The impedance is 20Ohm, so the max available current is 1.2A.
   To limit the current at 0.7A, the duty cycle is 58%.

This parameter is useful for dancer applications by limiting the current at the lowest value needed to pull the dancer for the max roll with the max tension.

6.4 ALARM management function

Principle

Two digital outputs have been designed to provide two different alarm signals:
Regulation fault: When the Measurement - Set point difference is over the pre-set tolerance, it means that there is something wrong in the process.

Min. Diameter: Diameter measurement threshold available to alert the operator before the real end of the bobbin.

How does it work

Error range parameter: The digital output AL1 will be closed for an actual Measurement - Set point difference higher than the chosen percentage.
Diam Threshold parameter: The digital output AL2 will be closed for an actual Diameter measurement below the chosen percentage of full scale diameter.

Example

Error range:
For a 5 kg set point and 10 % Error range, the AL1 output will be closed for a measurement out of the 4.5 to 5.5 kg range (+/- 10 % of the current set point)

Diam Threshold :

Diameter range = 0.2 to 1.0 m
Actual working range = 1.0 - 0.2 = 0.8 m
For 5 % Diam threshold, the AL2 output will be closed as soon as the actual diameter is lower than 0.24 m
Alarm diameter = core diameter + (Actual working range x Diameter threshold) 0.2 + (0.8 x 5%) = 0.24m

Process

AL1 and / or AL2 digital outputs remain closed until the time that the related measurements are out of the correct range.

CAUTION: AL1 and AL2 are driven by optocoupling components. The common (0 V) point for both is AL-
Max output capability: Vceo = 300 V

7.1 Digital Inputs A and B

Principle

The digital inputs A and B are dedicated to the management of the controller's global status. It provides the user the ability to create an automatic relationship between the machine process and the controller status (i.e. to manage the E-Stop needs).

How does it work

The following table shows the controller's main status for any different combination of A and B switch positions, as long as the No-Stop mode is not activated (see SPECIAL FUNCTIONS Menu / No-Stop Function).

A	B	Output AO1
0	0	Hold
0	1	Regul
1	0	Release
1	1	E-Stop

0 means: Switch Open / 1 means: switch closed (to the 24Vdc terminal)

The operator control panel (front face keyboard functions) remains the priority control.

7.2 Logical inputs Reg and Init

Principle

The digital inputs Reg and Init are dedicated to the management of the P.I.D. calculation process.

How does it work

The following table shows the calculation process status for any different combination of Reg and Init switches positions:

Init	Reg	PID calculation
0	0	calculation stopped
1	0	calculation initialization
0	1	calculation in process
1	1	calculation in process

0 means: Switch Open / 1 means: switch closed (to the 24Vdc terminal)

8.1 DATA CAPTURE Menu

Starting a Data Capture

The PC software includes a Data capture function, allowing to visualize and to record each Controller input/output actual value/status, four times/sec. To start a data capture, go to the REGULATOR / Start Acquisition option.

To record the data on the computer, enter a new File name (ext., .acq). The data capture will start and the data will be saved in the related file. To look at the data without recording, choose 'Cancel.' The data capture will be started without recording. In both cases, press 'Stop' to end the data capture process.
Using the recording option during the data capture allows you to store the data on the disk as a data file (ext., .acq). The data is displayed as a text file (columns separator = Tab) which can be read by any spreadsheet software.

NOTE: The data is collected 4 times / sec, meaning the time base between two lines is 250 ms (1/4s) .

How to display the acquired file

To display the curves of the acquired file, click on the menu 'acquisition' then select 'visualize' or click directely in the icon bar. A new window opens and you have to load the acquired file. Select the curves you want to see. A multi-curves option can be selected when clicking in 'customize'.

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